



Critical Agricultural Research and Extension



# Assessment of Spent Hemp Biomass as a Feed for lactating dairy cows

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Fiber

Decortivating



Bast fiber



Hurd

By-product

Hemp stubble



Seed/Grain

Hulling

Flour

Pressing



Hemp oil

By-product



Hempseed cake/meal



Leaves/Flower

Extraction



Essential compounds

- Full-spectrum oils
- THC-free oil
- Terpenes
- Cannabidiol (CBD)
- Other cannabinoids

By-product



Spent hemp biomass



Feed ingredients for livestock

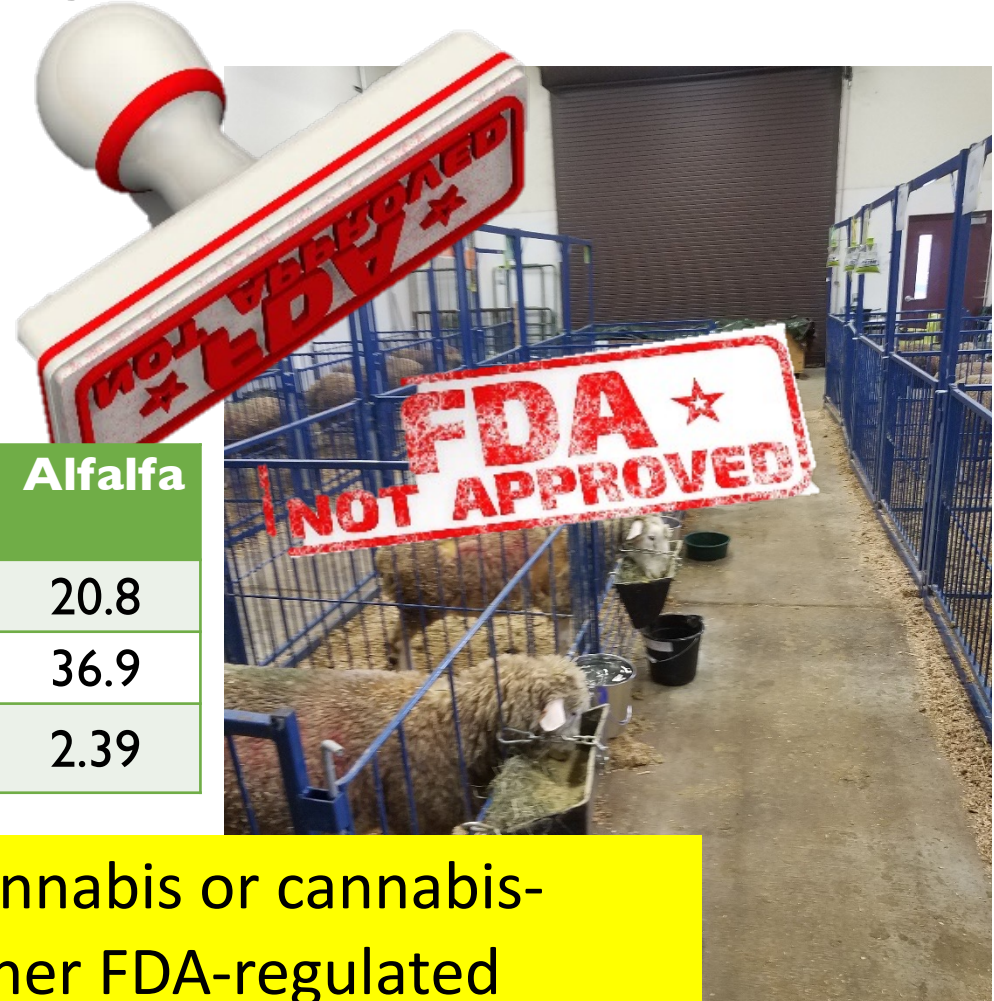
Hemp = <0.3% THC = Legalized in 2018 Farm Bills



Spent hemp biomass



| Component | SHB  | Alfalfa |
|-----------|------|---------|
| Protein   | 19.2 | 20.8    |
| NDF       | 23.4 | 36.9    |
| ME        | 2.67 | 2.39    |



“[...] we treat products containing cannabis or cannabis-derived compounds as we do any other FDA-regulated products [...] because both CBD and THC are active ingredients in FDA-approved drugs [...]. Under the FD&C Act, it’s illegal to introduce drug ingredients like these into the food supply, or to market them as dietary supplements.”



# Nutrient composition

| Component                | Unit    | SHB  | Alfalfa meal |
|--------------------------|---------|------|--------------|
| Dry Matter               | %       | 89.6 | 90.9         |
| Crude protein            | % DM    | 19.2 | 20.8         |
| Soluble Protein          | % CP    | 28.0 | 31.0         |
| Acid Detergent Fiber     | % DM    | 17.6 | 30.8         |
| Neutral Detergent Fiber  | % DM    | 23.4 | 36.9         |
| Non-Fiber Carbohydrate   | % DM    | 37.7 | 30.3         |
| Crude fat                | % DM    | 7.5  | 1.6          |
| Metabolizable Energy     | Mcal/kg | 2.67 | 2.39         |
| Net Energy for Lactation | Mcal/kg | 1.59 | 1.36         |



No pesticides, mycotoxins, terpenes, and heavy metals

# Late lactation cows

- Feed intake
- Blood
- Carageenan

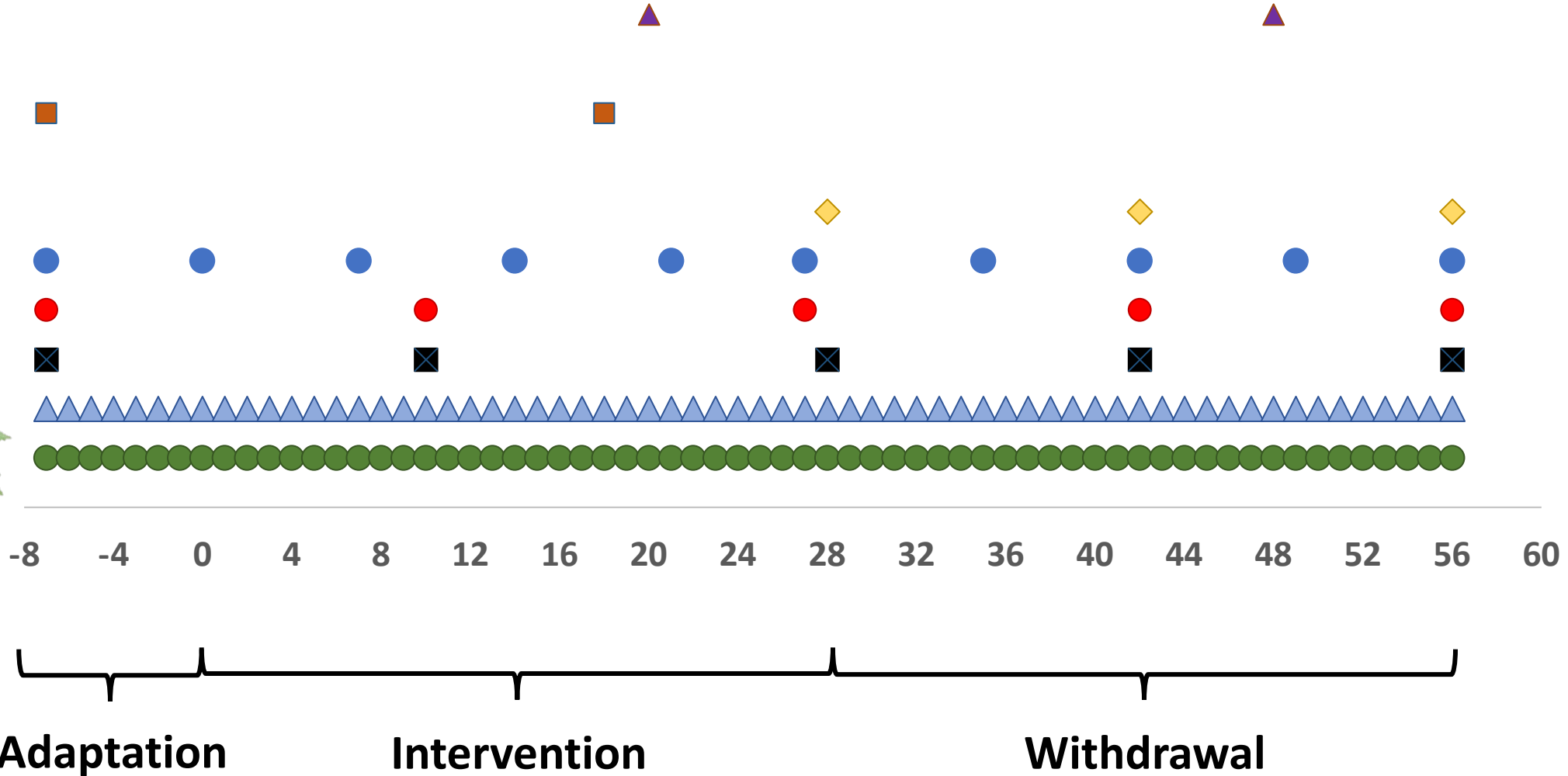
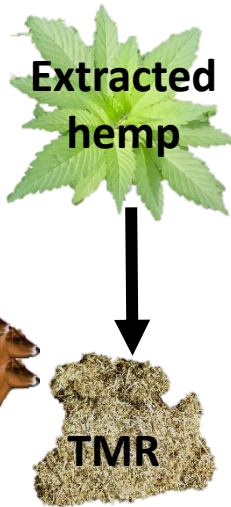
- ▲ Milk yield
- Milk sample
- ▲ Methane/Urine

- ⊠ BW/BCS
- ◆ Adipose/Muscle/Liver biopsy

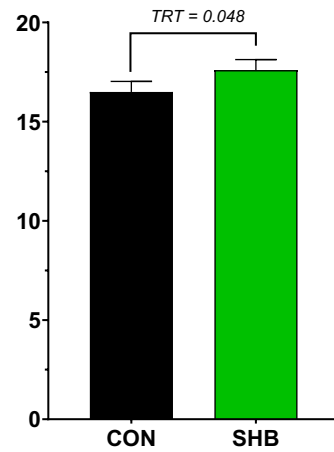
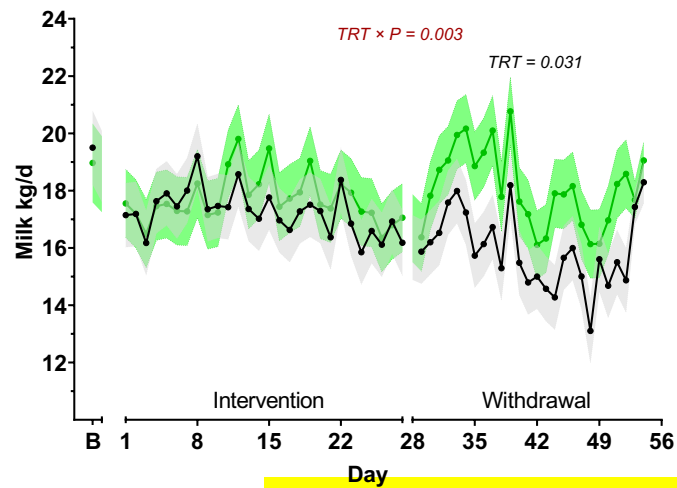
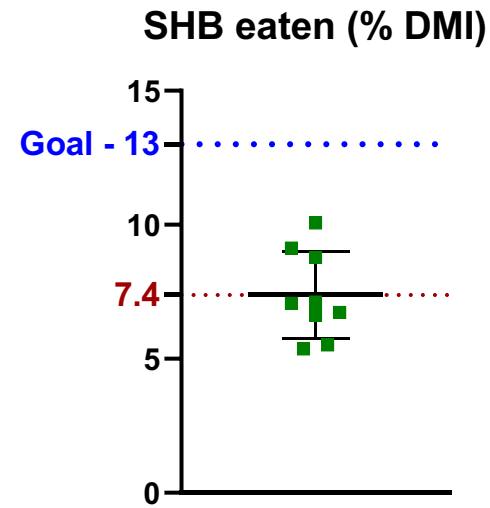
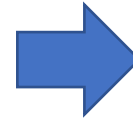
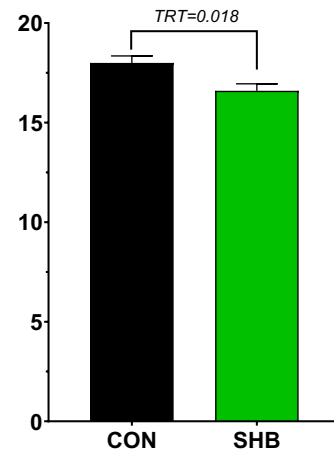
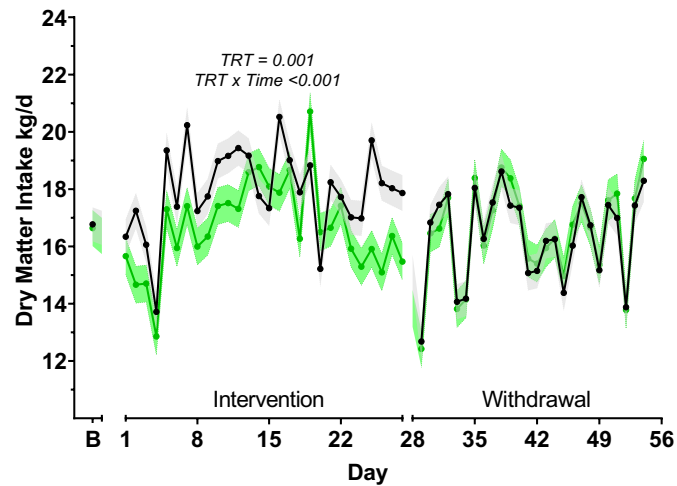
CON (alfalfa)  
(n=9)



TRT (hemp)  
(n=9)



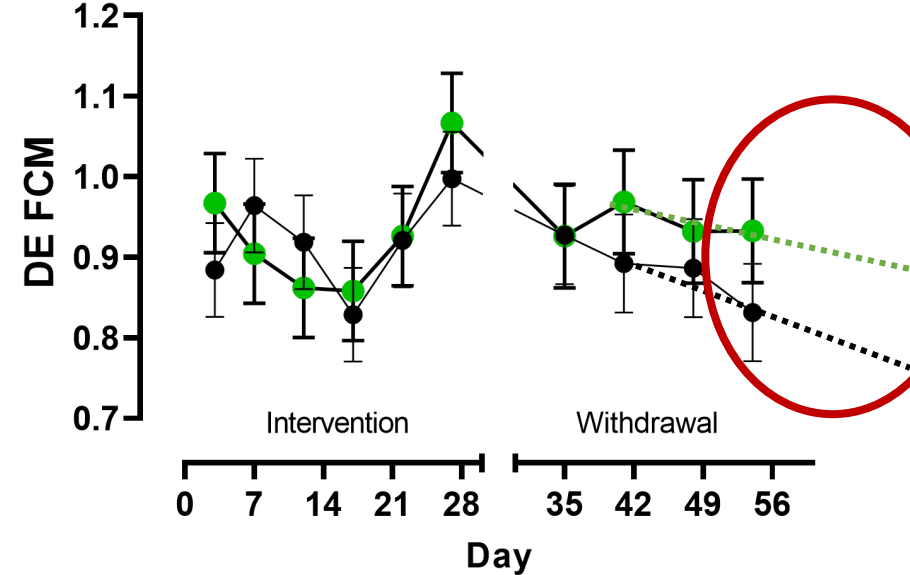
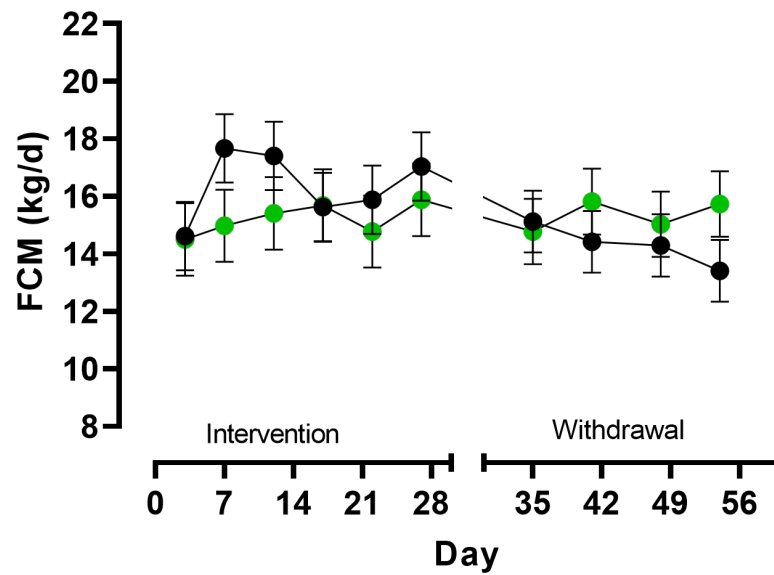
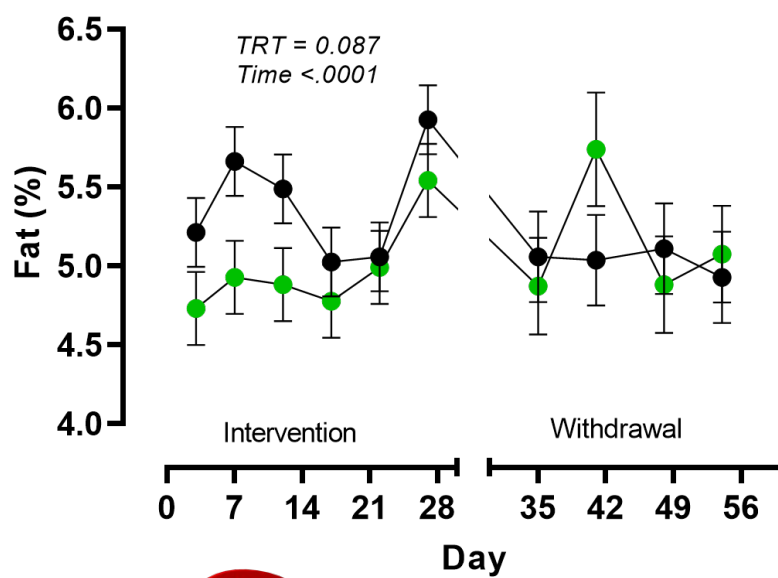
# Dry matter intake & Milk production



**SHB is not palatable!**



# Feed efficiency (dairy efficiency)

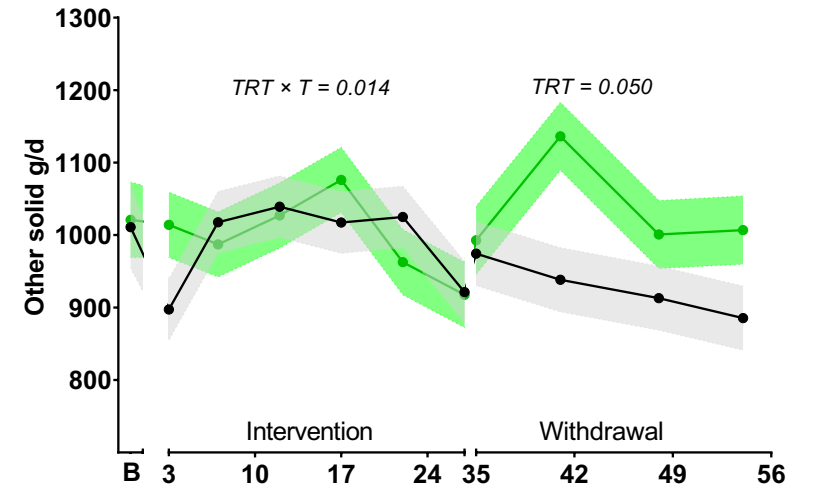
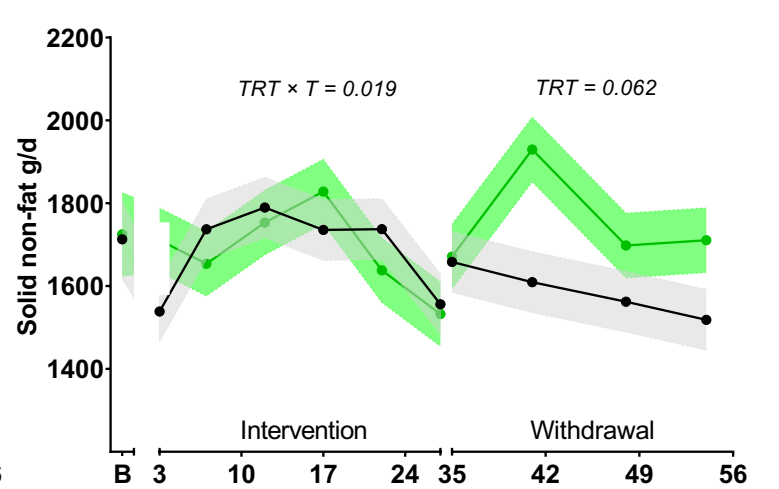
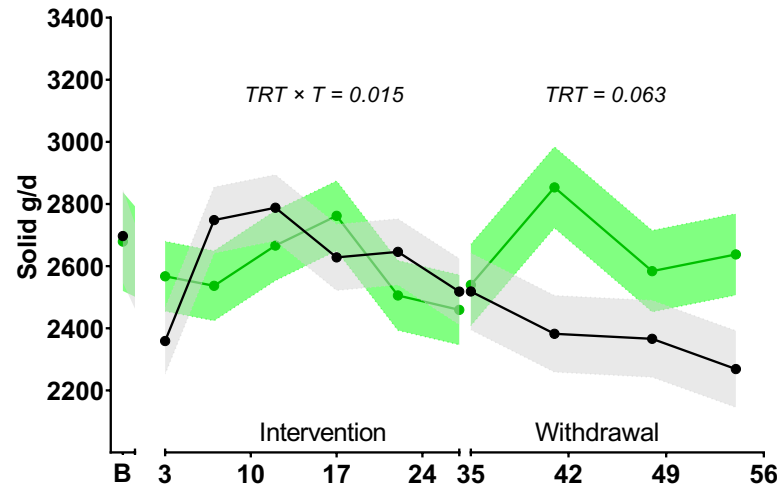
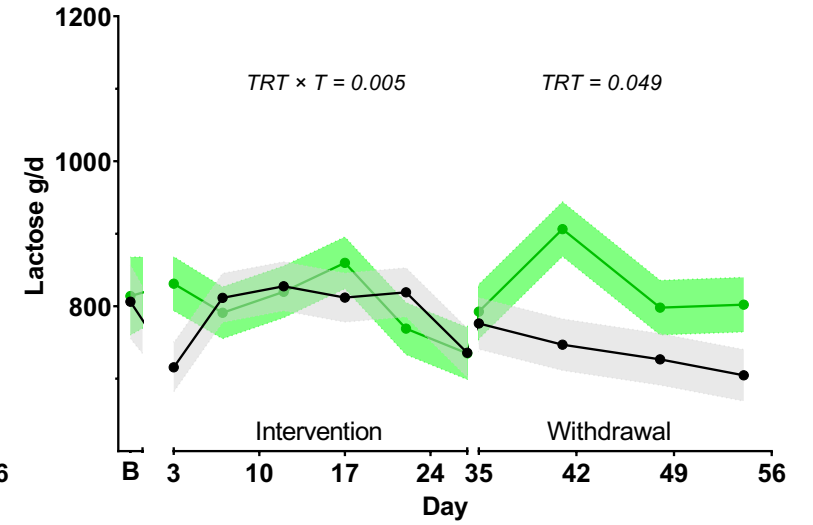
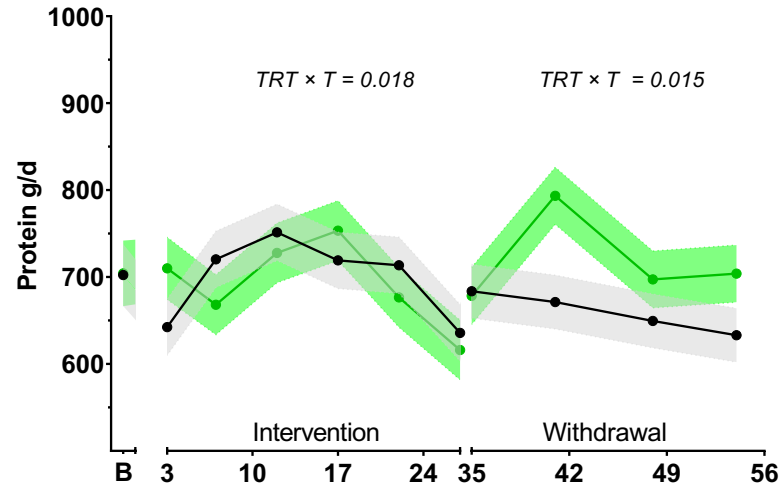
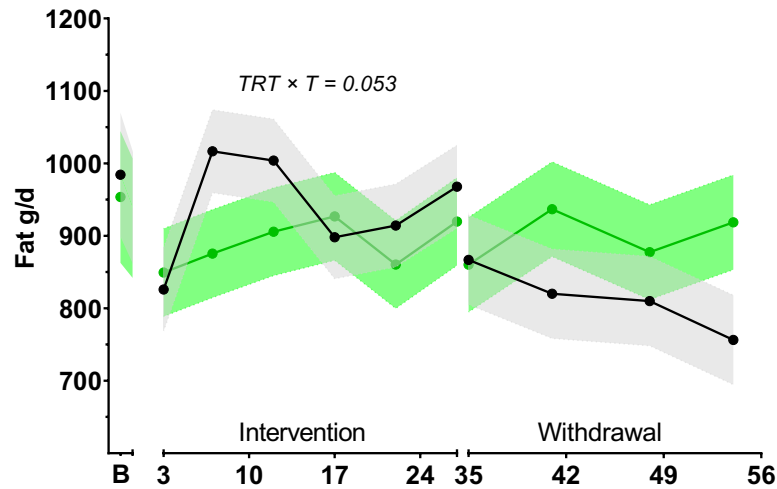


No effect on milk protein and lactose but decrease butterfat

**No higher feed efficiency → long term?**

# Milk components

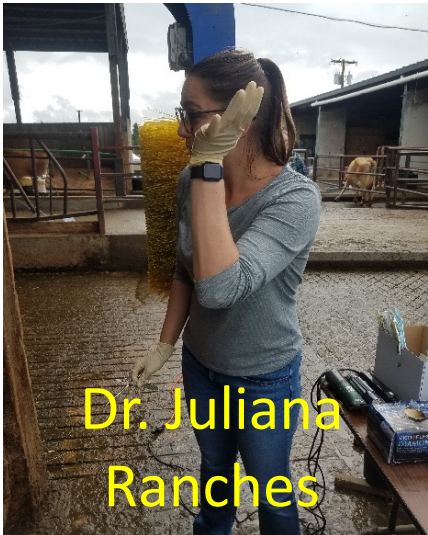
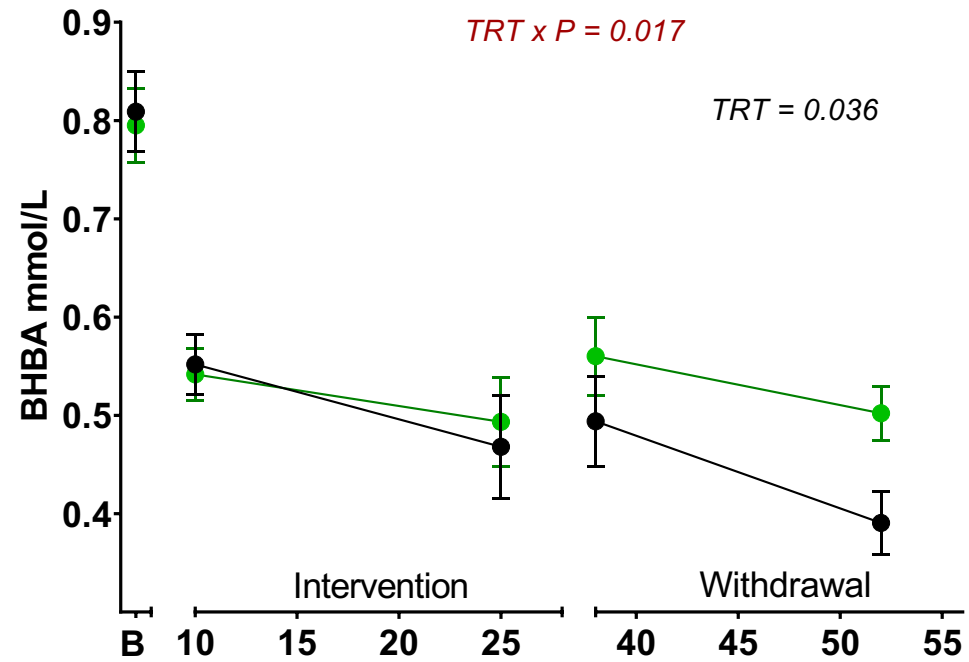
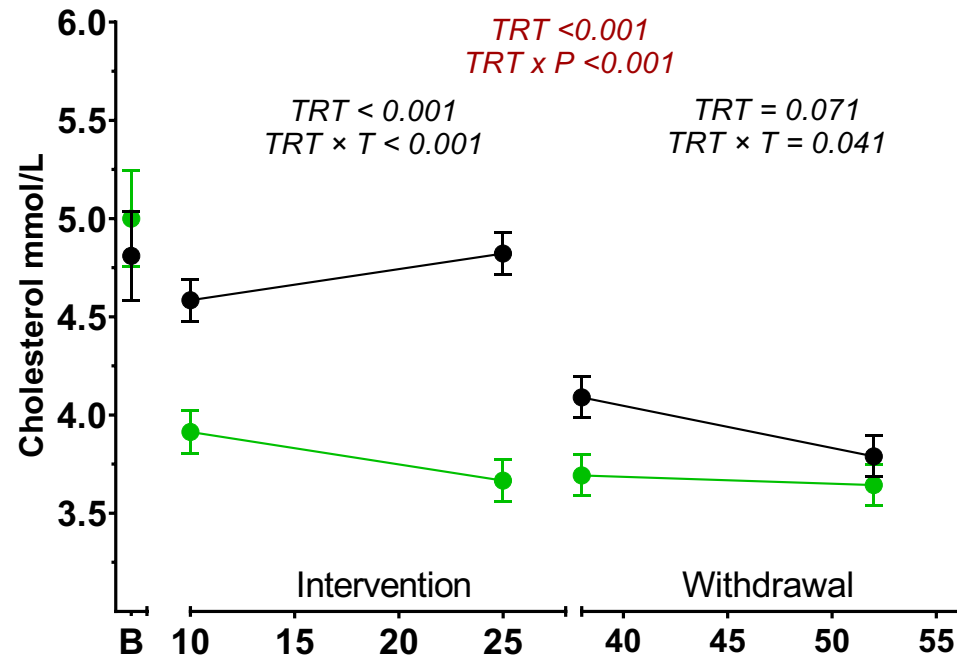
● Control ● Spent Hemp Biomass





# Metabolism

● Control ● Spent Hemp Biomass



Dr. Juliana  
Ranches

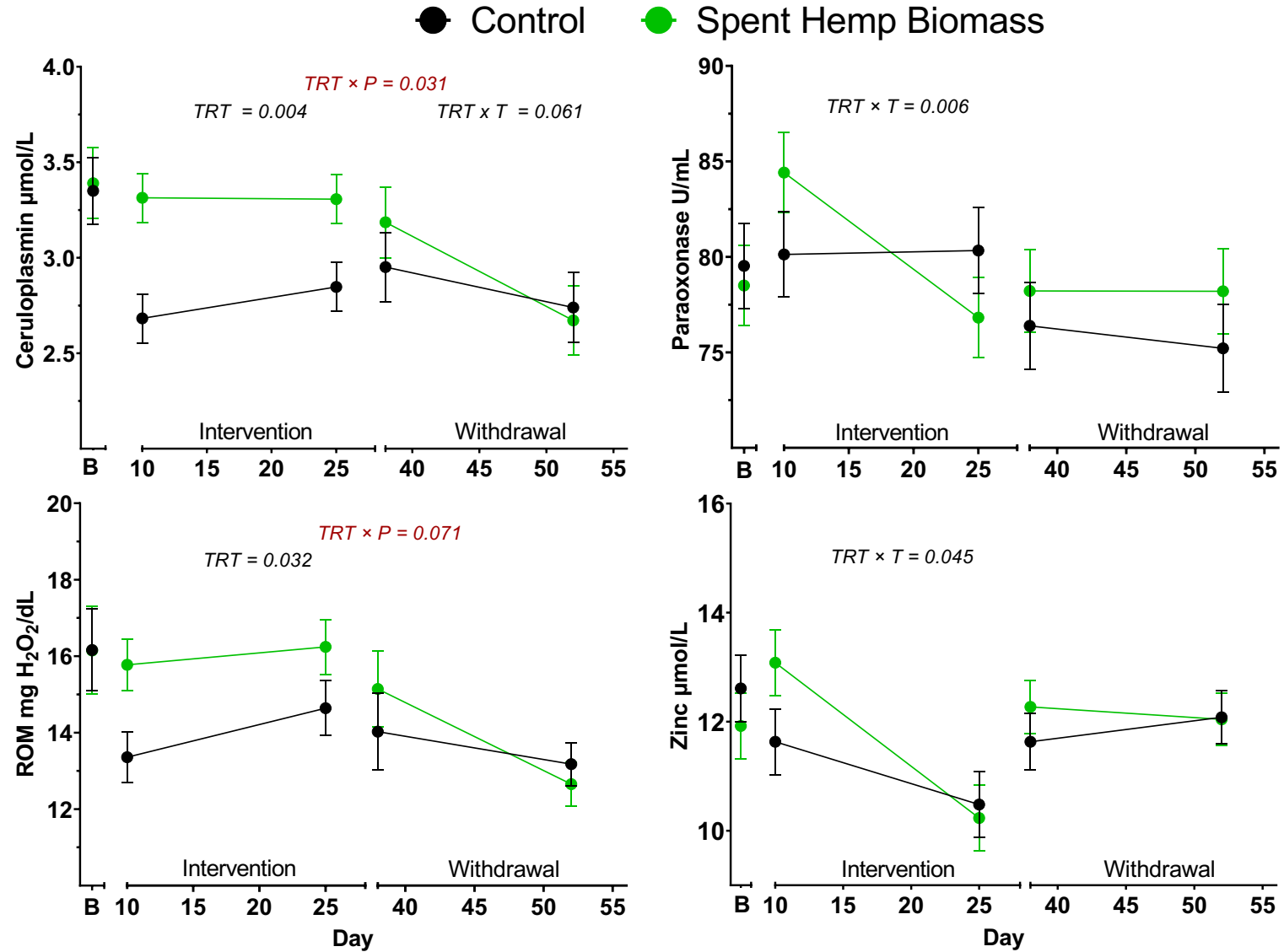


Dr. Charles  
Estill



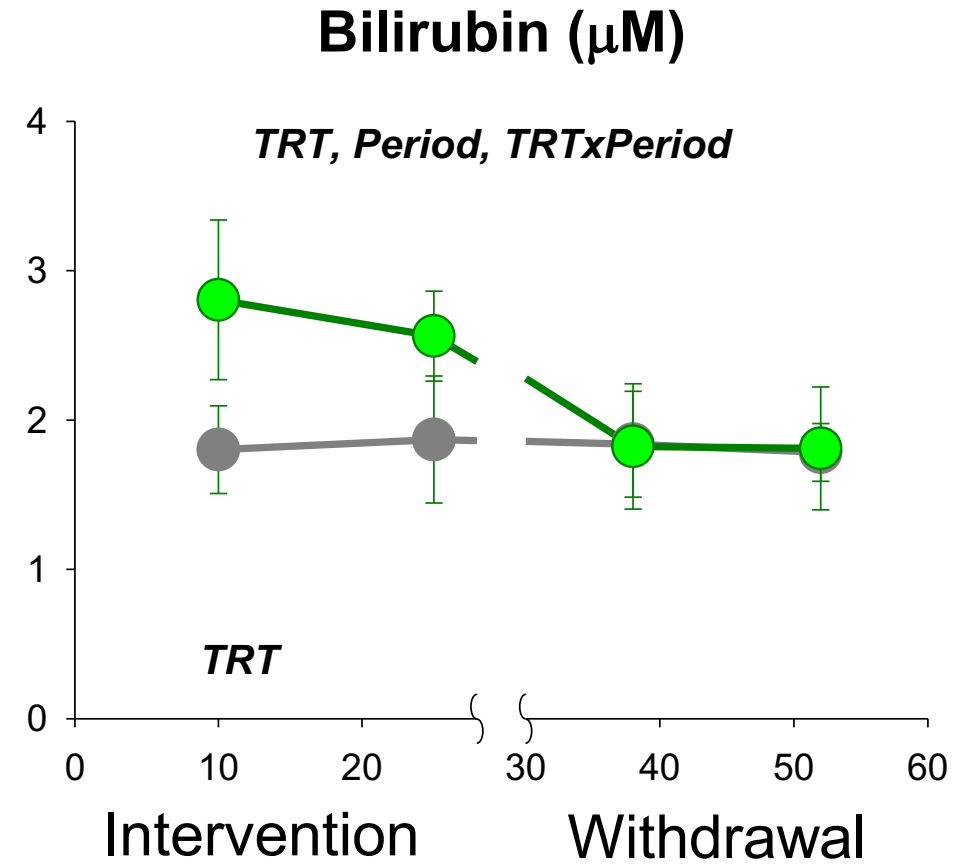
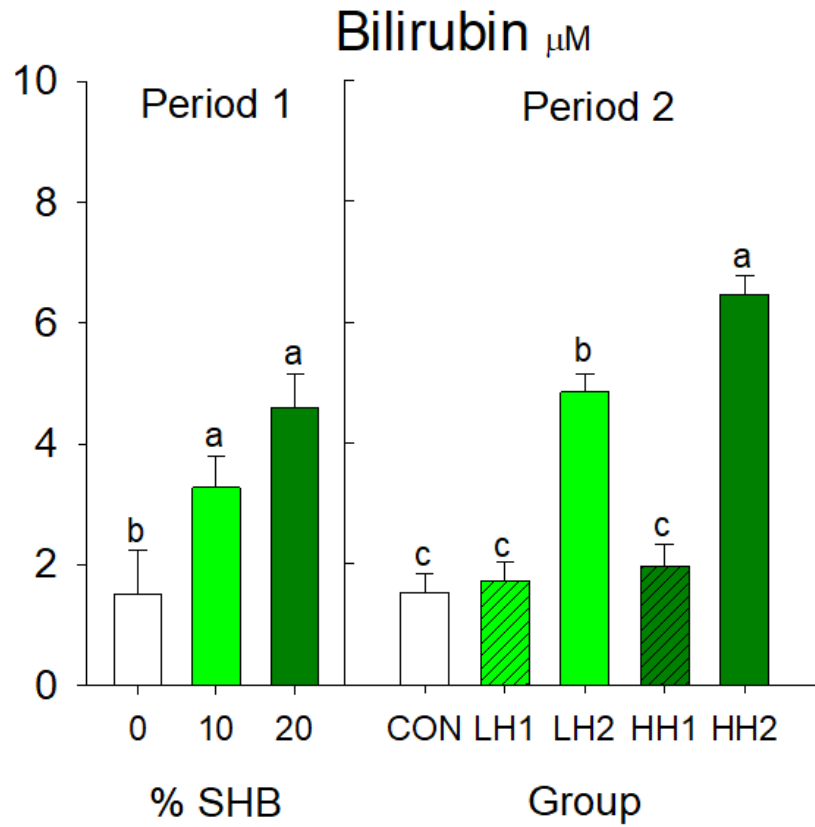
**Intervention:**  
**Low feed intake**  
**Effect on the microbiota?**

# Inflammation and oxidative stress



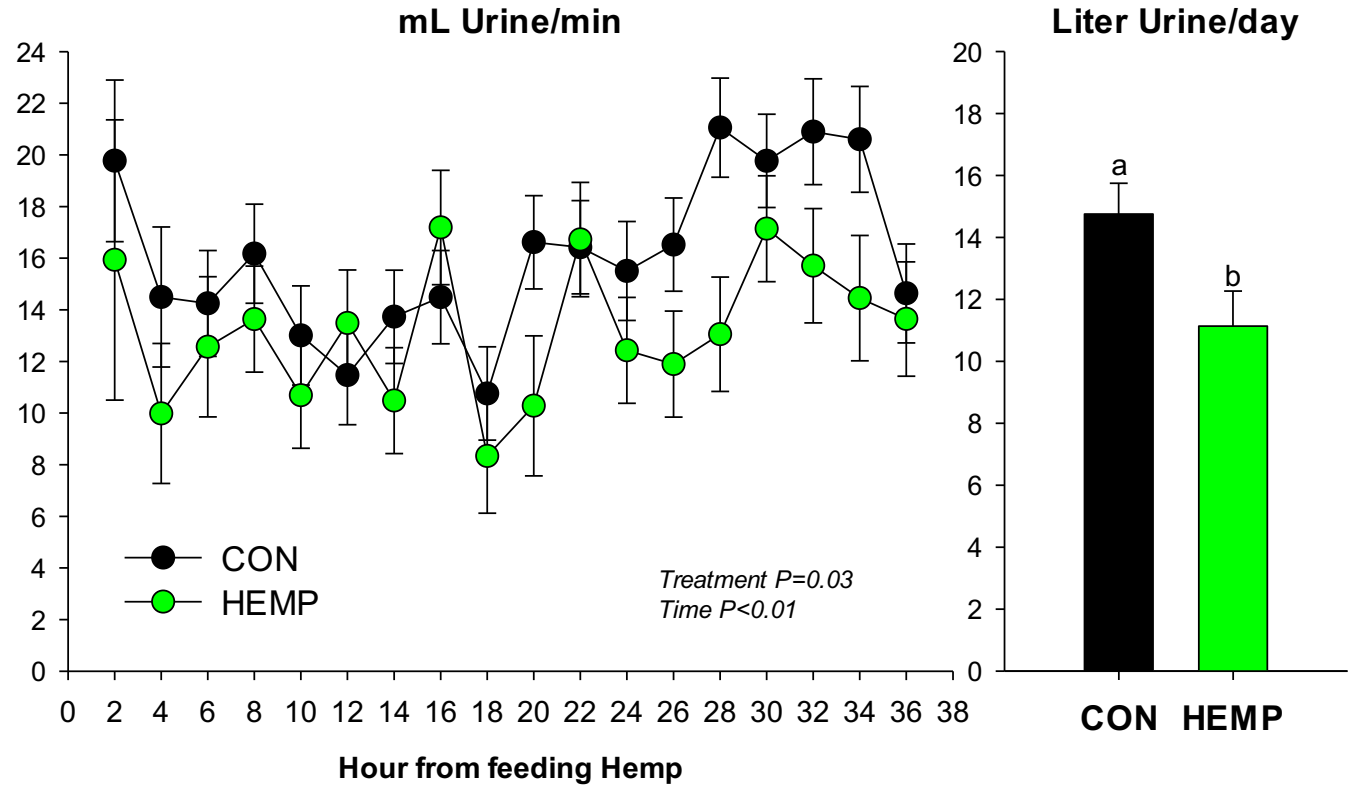
Intervention  $\rightarrow$  Inflammation

# Liver



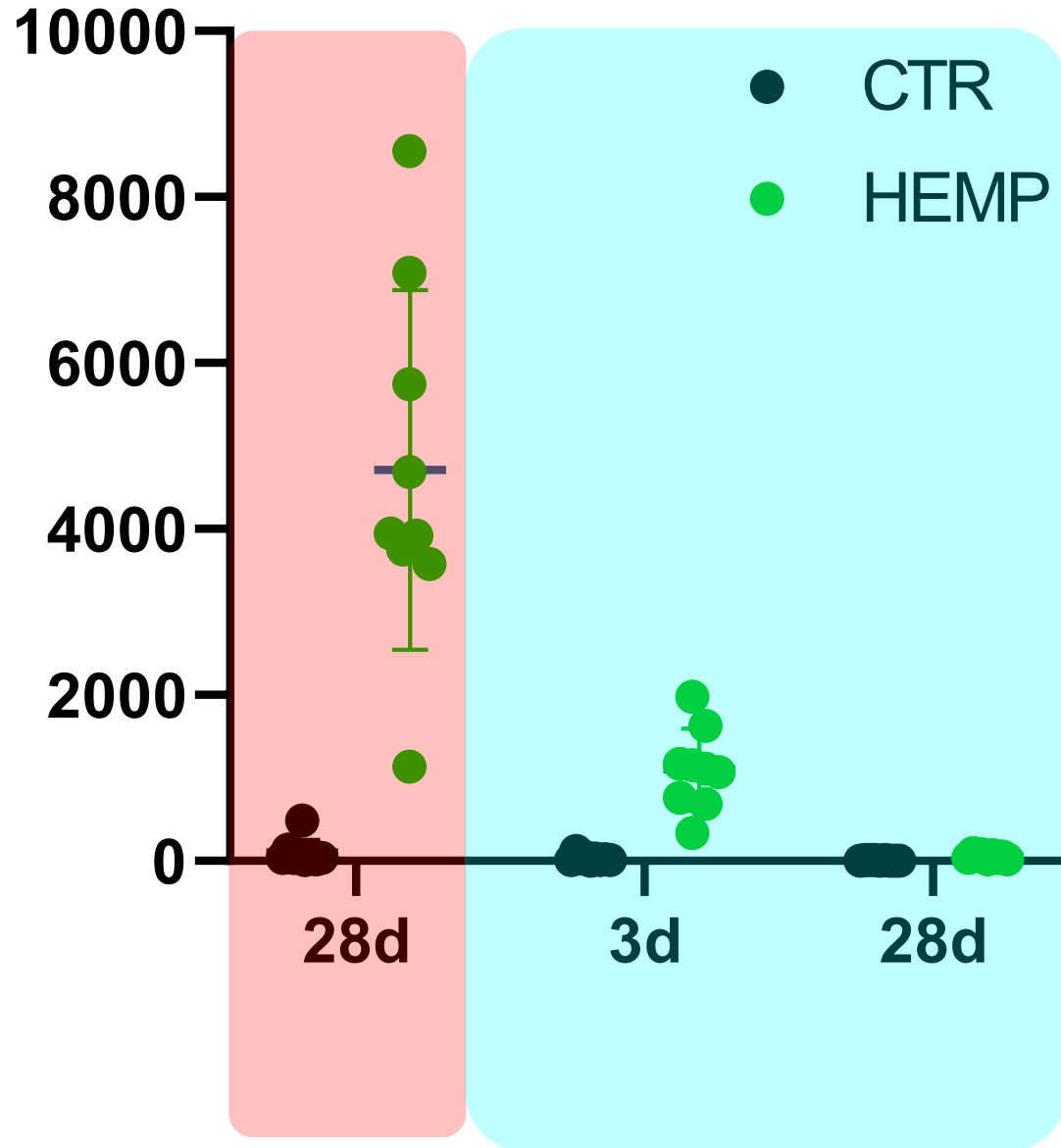
**Intervention:**  
**No liver damages**  
**↓ liver clearance**

# Urine production and N metabolism



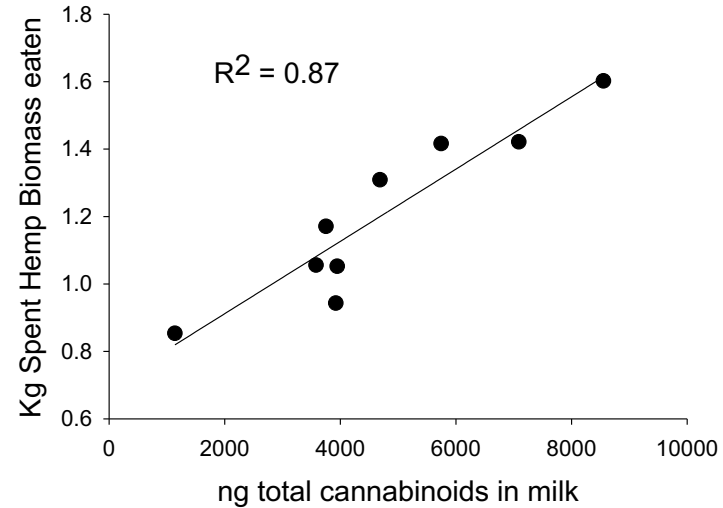
Ongoing → Nitrogen metabolism

# Cannabinoids (ng/mL)



# Cannabinoids in milk

4 days of withdrawal sufficient to eliminate cannabinoids



**Transfer to milk**  
 CBD = 0.41%  
 THC = 0.19%  
 Others = <0.10%

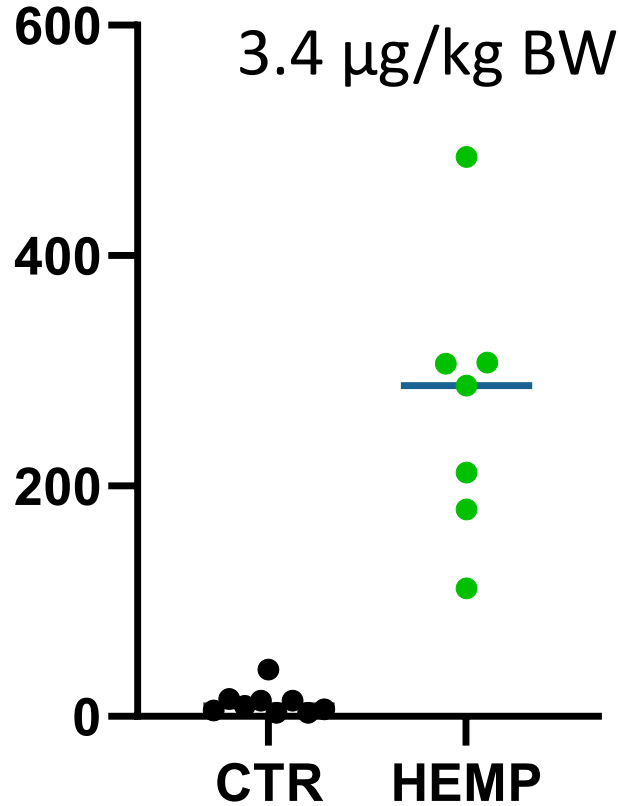
▶ 3.36 ng/mL → 3 cups milk → 2.1 μg THC/kg BW



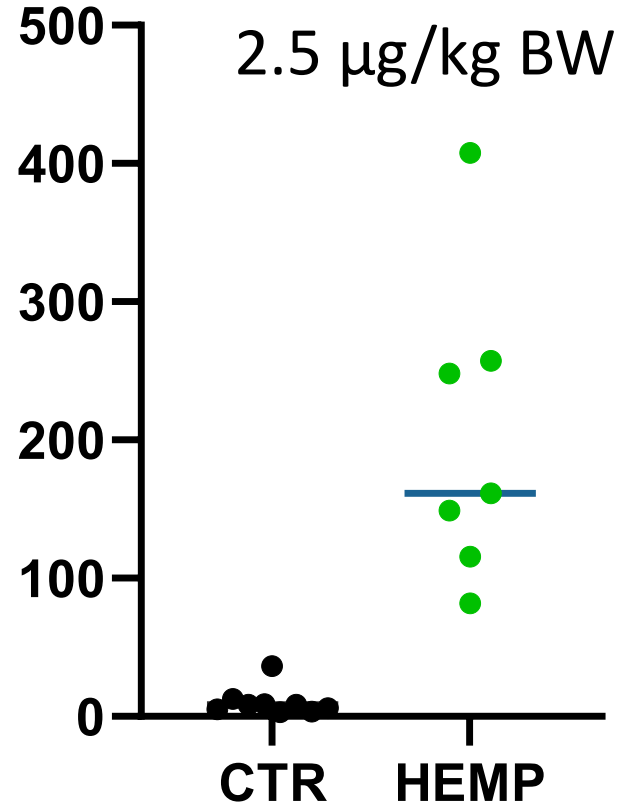
**Tolerable Dose Intake**  
 EU → 0.4 μg THC/kg BW  
 AuNZ → 6.0 μg THC/kg BW

# 7 day post-partum

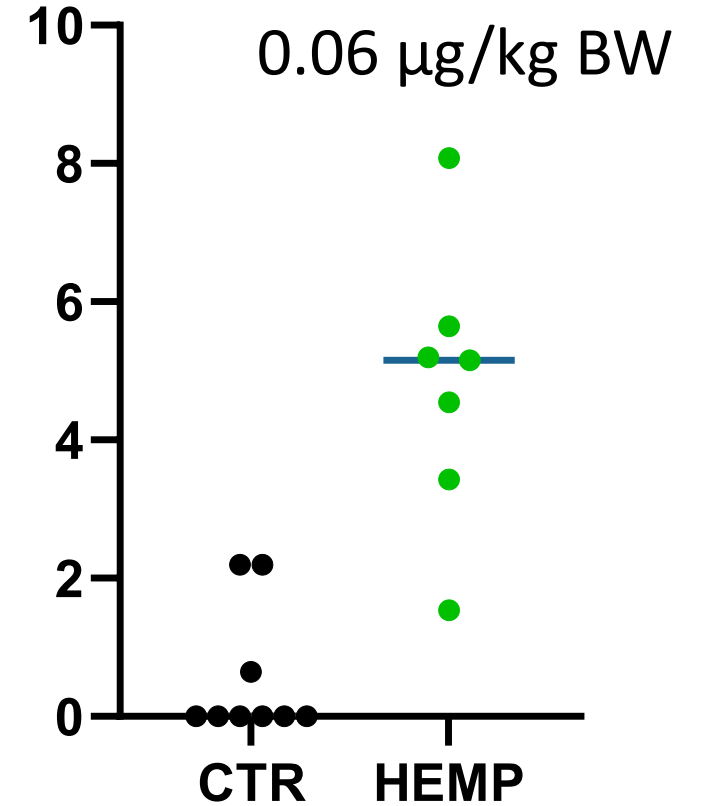
## Cannabinoids (ng/mL)



## CBDA (ng/mL)



## $\Delta 9$ -THC (ng/mL)



Epidiolex® → 200 mg/kg

Tolerable Dose Intake  
EU → 0.4  $\mu\text{g}$  THC/kg BW  
AuNZ → 6.0  $\mu\text{g}$  THC/kg BW

# Summary and Conclusions

## Animal performance and health:

- ↓↓ palatability
- ↓↓ feed intake → what about long term?
- ↑↑ milk production and might be long term higher efficiency?
- Some effect on metabolism → maybe effect on rumen microbiota?
- Slight inflammation → no liver damages
- Decreased liver clearance → issues for drugs use?

## Cannabinoid residuals in milk:

- Present during intervention → likely not an issue for human consumption
- Clearance of cannabinoids is fast (4 days)

# Acknowledgments

## Undergraduates Research Assistants



Dr. Hunter Ford



Dr. Sebastiano Busato



Larissa Lewis  
OSU Dairy Manager



Alyssa Thibodeau



Corinna Cauchy

## Cannabinoid analysis, College of Pharmacy



Dr. Richard van Breemen



Dr. Daniel Nosal





An aerial photograph of a university campus during autumn. The scene is filled with trees in shades of yellow, orange, and red. Several large, multi-story brick buildings are scattered throughout the campus. A central green lawn is visible, with a few people walking on it. The overall atmosphere is peaceful and scenic.

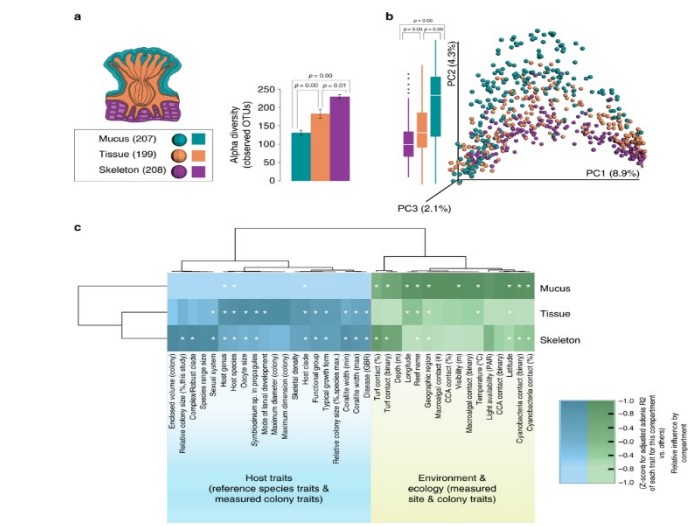
**THANK YOU**

# What's Next?

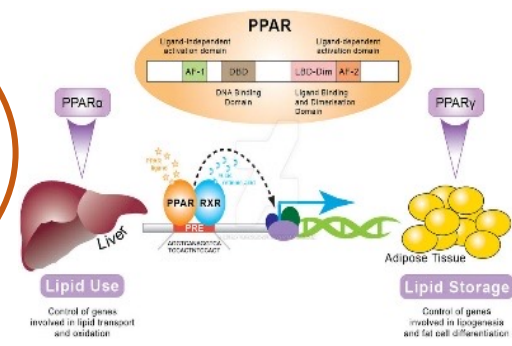
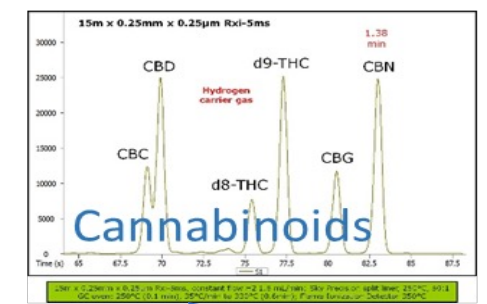
Microbiome Profiling  
RNA seq



**Biopsies & ruminocentesis**  
Liver, Muscle, Adipose  
Tissue, Rumen content



## Pharmacokinetics



## Transcriptome

